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PACKAGING DEVICE AND PACKAGING METHOD  
FOR HOLLOW CATHODE TYPE SPUTTERING TARGET

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## TECHNICAL FIELD

The present invention relates to a packaging device and packaging method of a hollow cathode sputtering target capable of preventing the adhesion of dust and dirt, and preventing humidity and oxidization.

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## BACKGROUND

In recent years, the sputtering method for forming a film from materials such as metal or ceramics has been used in numerous fields such as electronics, corrosion resistant materials and ornaments, catalysts, as well as in the manufacture of cutting/grinding materials and abrasion resistant materials.

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Although the sputtering method itself is a well-known method in the foregoing fields, recently, particularly in the field of electronics, a sputtering target suitable for forming films of complex shapes and forming circuits is in demand.

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Under the foregoing circumstances, a hollow cathode sputtering target has been proposed in recent days. This target takes on a cup shape, and the name "hollow cathode sputtering target" derives from this shape (e.g., refer to Patent Documents 1, 2, 3).

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This hollow cathode sputtering target is capable of generating high density plasma within the target, and, by further adding directivity to the sputtering direction, a performance is yielded where it is possible to fill via holes in a high aspect ratio without having to use the conventional collimator.

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This kind of hollow cathode sputtering target has the function of a deposition method capable of forming a film more efficiently and with more control in

comparison to a conventional flat-plate target.

Generally speaking, in order to ship and store a flat-plate target, such target is placed inside a resin bag, and the inside is subject to vacuum suction or inert gas is introduced therein so as to prevent the adhesion of dirt and oxidization (e.g., refer to  
5 Patent Documents 4, 5).

[Patent Document 1]

Japanese Patent Laid-Open Publication No. 2000-256843

[Patent Document 2]

10 Japanese Patent Laid-Open Publication No. 2001-98367

[Patent Document 3]

Translation of Publication of International Application No. 2002-531690

[Patent Document 4]

Japanese Patent Laid-Open Publication No. H4-231461

15 [Patent Document 5]

Japanese Patent Laid-Open Publication No. 2001-240959

The method of performing vacuum suction with this kind of bag is effective in preventing the adhesion of dirt and oxidization. Nevertheless, when this is applied  
20 to a hollow cathode sputtering target, there is a difficult problem in terms of structure.

As shown in FIG. 2, a bag 3 adheres (is tethered to) a peripheral edge 2 of a hollow cathode sputtering target 1, a void 4 cannot be sucked sufficiently, and there is a problem in that this is an insufficient preventive measure for preventing oxidization.

25 Further, since the void 4 will be decompressed, there is another problem in that the resin bag will be pulled inward, and tension thereof could cause the bag to burst. Reference numeral 7 in FIG. 2 represents a vacuum suction unit.

## DISCLOSURE OF THE INVENTION

Thus, an object of the present invention is to provide a packaging device and packaging method of a hollow cathode sputtering target capable of performing vacuum suction even to the inside of the hollow portion covered with the resin bag.

5 The present inventors discovered that the foregoing problems could be overcome by providing a cover for covering the void of the hollow cathode sputtering target, and devising such cover in a certain way.

Based on the foregoing discovery, the present invention provides: 1) a packaging device of a hollow cathode sputtering target, including: a hollow cathode sputtering target; a cover of a size capable of covering a void of the target, one or  
10 more through-holes provided to the cover, a resin bag of a size capable of covering them all, and a device for performing vacuum suction to the inside of the bag; 2) the packaging device of a hollow cathode sputtering target according to 1) above, wherein the cover is transparent resin; 3) the packaging device of a hollow cathode sputtering target according to 1) or 2) above, wherein the resin bag is a bag that is  
15 impermeable to oxygen and moisture; and 4) the packaging device of a hollow cathode sputtering target according to any one of 1) to 3) above, wherein the cover has rigidity, and is formed from a flat plate that is capable of maintaining its shape after the vacuum suction.

The present invention also provides: 5) a packaging method of a hollow  
20 cathode sputtering target, including the steps of installing a cover of a size capable of covering a void of the target; providing one or more through-holes to the cover; placing a resin bag over them, and performing vacuum suction to the inside of the bag; 6) the packaging method of a hollow cathode sputtering target according to 5) above, wherein the cover is transparent resin; 7) the packaging method of a hollow  
25 cathode sputtering target according to 5) or 6) above, wherein the resin bag is a bag that is impermeable to oxygen and moisture; and 8) the packaging method of a hollow cathode sputtering target according to any one of 5) to 7) above, wherein the cover has rigidity, and is formed from a flat plate that is capable of maintaining its shape after the vacuum suction.

## EFFECT OF THE INVENTION

The present invention yields a superior effect in that it is capable of evacuating the void of the target via the through-holes provided to the cover upon performing vacuum suction to the hollow cathode sputtering target covered with a resin bag, and, in the void to become the eroded portion of the target, it is possible to maintain the cleansed target surface without even once coming in contact with the packaging resin. Therefore, a significant effect is yielded in that it is possible to further prevent the adhesion of dust and dirt and prevent humidity and oxidization in comparison to conventional methods.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional schematic diagram for explaining the packaging of a hollow cathode sputtering target of the present invention; and

FIG. 2 is a cross-sectional schematic diagram for explaining the problems arising in the conventional packaging of a hollow cathode sputtering target.

## BEST MODE FOR CARRYING OUT THE INVENTION

The hollow cathode sputtering target of the present invention is now explained with reference to FIG. 1. FIG. 1 is a view showing a frame format of a representative shape of the hollow cathode sputtering target 1.

Here, although the cross section is taking on a U-shape, there is no particular limitation on this shape, and the present invention is applicable to all targets as long as the target has voids inside; for instance, targets having a W-shaped cross section. The present invention covers all such shapes.

Further, there is no particular limitation on the target material, and various metals, alloys, and ceramics of silicon compounds and oxides may be used. In order to manufacture a hollow body (cup shape), processing methods such as

forging, rolling, thread rolling, deep drawing and the like are performed. There is also no limitation on these manufacturing methods.

Generally, the inner face of the hollow cathode sputtering target 1 becomes the eroded face, and such inner face is smoothed stringently. Therefore, deterioration of such inner face of the target due to adhesion of dust, damage, oxidization and so on must be avoided.

The present invention provides a cover 5 for protecting the void 4. Through-holes 6 are provided to this cover 5. The cover 5 shall be formed from a material having rigidity which will not excessively deform or bend upon vacuum suction. Although a flat plate will normally suffice, a bar or handle for reinforcement may be provided, or it may be other three-dimensional shapes.

To allow the inside of the cover to be observed, it is desirable that the cover is transparent, and it is also desirable that the resin bag is a bag that practically does not permeate oxygen and moisture (humidity).

Incidentally, although it is desirable that the resin bag is able to completely shut off oxygen and moisture (humidity), this does not necessarily have to be the case. In other words, the meaning of "a bag that does not permeate oxygen and moisture (humidity)" of the present invention implies that the bag is able to shut out the oxygen and moisture (humidity) to a degree of not being substantially influenced by such oxygen and moisture (humidity) at least upon shipping or storing the sputtering target. The present invention shall cover all of the foregoing cases.

One or more through-holes 6 are provided to the cover 5, and these play an important role during vacuum suction. This is because the hollow portion 4 can be evacuated through these through-holes 6.

The cover 5 is placed on the target 1, the bag 3 formed from polyvinyl chloride or the like is covered thereon, and vacuum suction is performed through the vacuum suction unit 7. Although the vacuum suction device is not shown, a generally used suction device may be used.

When evacuating the hollow portion 4 through the through-holes 6 provided to the cover 5, the bag will not adhere to the peripheral edge 2 of the target, and an

incomplete evacuation will not occur.

After evacuation, an inert gas may be introduced therein, or this may be stored and shipped in such evacuated state. As a result, it is possible to effectively prevent the adhesion of dust and dirt on the inner face of the target, and  
5 prevent humidity and oxidization.

Further, in the void to become the eroded portion of the target, there will no longer be any contact from above the packaging resin, and risks of the inner face of the target becoming damaged will decrease considerably. Moreover, even the packaging resin will not be touched. Therefore, a significant effect is yielded in that  
10 the cleansed target surface can be maintained as is.

#### INDUSTRIAL APPLICABILITY

The present invention is optimal for packaging a hollow cathode sputtering  
15 target since it is able to prevent the adhesion of dust and dirt as well as effectively prevent humidity and oxidization on the inner surface of a target having a void.